

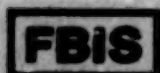
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11 February 1980

USSR Report

SPACE

No. 2



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I. MANNED MISSION HIGHLIGHTS

CHRONOLOGY OF SALYUT-6 MISSION

[Editorial Report] The Soviet news agency TASS reports the following information on activities connected with the flight of the "Salyut-6" orbital scientific station:

29 November

On 29 November "Salyut-6" marked its 26th month in near-earth orbit and by 1400 hours Moscow time had completed 12,470 orbits of the earth. Tests of the station's on-board systems continued.

Orbital parameters were as follows:

- apogee, 372 km;
- perigee, 352 km;
- orbital period, 91.5 min;
- inclination, 51.6° . (Moscow TASS in English 1420 GMT 29 Nov 79)

16 December

Soyuz-T Launched

The Soyuz-T transport ship was launched at 1530 hours Moscow time in an unmanned version and inserted into an orbit with the following parameters:

- apogee, 232 km;
- perigee, 201 km;
- orbital period, 88.6 minutes;
- inclination, 51.6° . (Moscow TASS in English 1425 GMT 16 Dec 79)

19 December

Soyuz-T Docked

At 1705 hours Moscow time the Soyuz-T transport ship was automatically docked with the Salyut-6 station at the transfer compartment. After docking the space complex flew in an orbit with the following parameters:

- apogee, 360 km;
- perigee, 342 km;
- orbital period, 91.3 min;
- inclination, 51.6° . (Moscow TASS in English 1650 GMT 19 Dec 79)

25 December

In connection with tests of the orientation and control systems, Soyuz-T was used to maneuver the entire space complex into a new flight trajectory:

- apogee, 382 km;
- perigee, 370 km;
- orbital period, 91.9 min;
- inclination, 51.6° . (Moscow TASS in English 0900 GMT 29 Dec 79)

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SYSTEMS MODIFICATIONS FOR SOYUZ-T TEST VEHICLE OUTLINED

Moscow PRAVDA in Russian 20 Dec 79 p 6

Moscow TRUD in Russian 20 Dec 79 p 6

Moscow IZVESTIYA in Russian 21 Dec 79 p 6

[Editorial Report] Through an interview with one of the designers of the Soyuz-T test vehicle (his name is not given), PRAVDA correspondent V. Gubarev reveals that the modified space transport ship incorporates the following innovations:

- 1) a "new orientation system"
- 2) "new radio communication systems, in which the latest achievements in microelectronics have been realized"
- 3) a "unified propulsion system": all Soyuz-T engines will draw upon a common fuel reserve
- 4) an "on-board computer complex ... to analyze the great volume of information necessary for approach and docking to the orbital station and to give commands to the control system"
- 5) two solar panels "so that the chemical batteries can be recharged during flight"

To this information TRUD correspondent I. Melenevskiy adds that the thrust of the softlanding engines has been increased, thereby reducing the speed and impact during the landing segment.

IZVESTIYA correspondent B. Konovalov also repeats these basic improvements, adding only that the transport ship's life support system has been "modified."

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FEOKTISTOV COMMENTS ON SOYUZ-T MODIFICATIONS

Moscow TASS in English 2225 GMT 19 Dec 79

[Text] Moscow, December 19, TASS--Tass correspondent Nikolay Zheleznov reports:

After four months of autonomous flight the orbital station Salyut-6 met today a transport ship from earth again--"Soyuz-T." This was the sixteenth link-up of the station with another spacecraft in the course of the 26 months of its orbital flight.

"The very fact that a space station has been actively functioning for such a long time is a considerable technical achievement," Dr Konstantin Feoktistov said, commenting on the new space launch. "We have sent now an improved ship to the Salyut in order to test it as part of an orbital complex."

"This time a telemetric reportage was transmitted for the first time directly from on board the spaceship. This was done with the help of a novelty--an onboard digital computing complex installed aboard the Soyuz-T. This complex is to ensure the execution of maneuvers, control over the condition of systems and transmission of processed current information back to earth. The same information is shown on a display screen aboard the ship. In the future, this will give the crew an opportunity of receiving quickly all the data concerning this or another maneuver or experiment."

"In this flight we are testing a new propulsion unit," Feoktistov went on. "If formerly various engines--for correction, docking and orientation--had autonomous power supply systems and different fuel components, now they are functioning in a system similar to the joint propulsion unit of the Salyut-6. Apart from other engineering advantages, this offers an opportunity for a more rational use of on-board fuel reserves. This was confirmed during the completed docking operation."

"The design of the Soyuz-T," Feoktistov went on, "also incorporates other novelties, reflecting the latest achievements of microelectronics and the science of materials. Individual elements of the life-sustaining, flight control and descent systems underwent some changes. All of them will be tested during the flight of the Salyut-6--Soyuz-T orbital complex."

[141-F]

II. SPACE SCIENCES

NEW APPROACH TO REPRESENTATION OF PLANETARY GRAVITATIONAL POTENTIAL

Moscow ASTRONOMICHSKIY VESTNIK in Russian Vol 13 No 4, 1979 pp 193-203

[Article by G. A. Meshcheryakov and A. N. Marchenko, L'vov Polytechnic Institute, "New Approach to Representation of Planetary Gravitational Potential by the Potential of a System of Point Masses"]

[Abstract] The authors propose a method for constructing a multipoint model of planetary gravitational potential: the total attraction potential (without discrimination of any normal part from it) was approximated by the potential of a system of $(l+2k)$ point masses; as the latter use was made of a set of point gravitational charges of approximate constructions of multipoles. A representation of planetary gravitational potential by the sum of its even and odd components was used. This makes it possible in computations of a $(l+2k)$ -point model of potential to interpret it as a $(l+k)$ -point model. A 13-point model of the earth's attraction potential was constructed. It corresponds to approximate constructions of its gravitational quadrupole and octupole and emphasizes well the principal peculiarities of the figure of the geoid (its "triaxiality," "pear" shape, and "bumpy" structure in a longitudinal direction). This model is recommended as a basis for constructing more detailed multipoint models of planetary gravitational potential. Figures 2; tables 1; references 20: 10 Russian, 10 Western.

[108-5303]

CSO: 1866

BRIGHTNESS INTENSIFIER WITH FIBER OPTIC FOR ASTRONOMICAL OBSERVATIONS

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 5 No 2, 1979
pp 110-112

[Article by I. N. Zaydel', V. A. Ganichev, P. V. Shcheglov and G. M. Lyapunov, "Brightness Intensifier With Fiber Optic for Astronomical Observations"]

[Abstract] Image converters have come into wide use in astronomy; the photo-contact brightness intensifier is an example of such instruments. This instrument is used in registering the faintest astronomical objects by means of contact photography. The principal shortcoming of these instruments has been the small size of the working field, which cannot be increased without a loss of resolution. This article describes a brightness intensifier with glass-fiber plates at the input and output. The use of plane-concave glass-fiber plates made it possible to increase the diameter of the working field, decrease distortion and considerably improve the distribution of resolution along the diameter of the working field. The total light losses caused by absorption are approximately 70%. In October 1977 this brightness intensifier was used in photographing the spectrum of night air glow. The observations were made at the Zvenigorod Station of the Institute of Atmospheric Physics. The instrument was mounted on the SP-50 spectrograph with a dispersion of 100 Å/mm. Photography was on A-600 photofilm by the contact method without an immersion medium. Among the instrument parameters are the following: integral response of multialkali photocathode -- 190 μ A/lumen, working voltage -- 14 KV, diameter of working field -- 24 mm, distortion of field edge -- 5%, field photometric error -- ~ 20%. Figures 4; references 2: 1 Russian, 1 Western.

[111-5303]

5303/CSO: 1866

III. INTERPLANETARY SCIENCES

IMPLICATIONS OF RADIO EMISSION OF JOVIAN SATELLITE IO

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 5 No 11, 1979
pp 622-624

[Article by M. G. Mingaliyev, Yu. N. Yariyskiy and Z. Ye. Petrov, Special Astrophysical Observatory USSR Academy of Sciences, "Discovery of Radio Emission of Io: Radiation Belts?"]

[Abstract] In December 1976 radio emission was registered at a wavelength of 3.9 cm from the Jovian satellite Io. Observations were with the RATAN-600 radio telescope. In January 1978 the radio emission was also observed at a wavelength of 2.08 cm. A total of seven curves of the transit of Io through the antenna directional diagram (3.9 cm) were obtained. The brightness temperatures were calculated to be 189 ± 38 and 600 ± 120 K at 2.08 and 3.9 cm respectively. The most natural explanation of the high brightness temperature in the radio range is the assumption that Io has a magnetosphere and radiation belts. It can be postulated that the excess radio emission of Io is due to the same electrons which cause the emission from the radiation belts of Jupiter. Assuming that the density of cosmic rays in the radiation belts of Io is close to their density in the radiation belts of Jupiter, it is possible to estimate the magnetic field of Io relative to the brightness temperatures of these belts at 3.9 cm. This indicates that the field strength in the radiation belts of Io is somewhat less than 1 oe. This evaluation must evidently be regarded as an upper limit because the density of cosmic rays in the magnetosphere of Io can be greater than in the Jovian radiation belts. Figures 3; references 3: 1 Russian, 2 Western.

[104-5303]

IV. LIFE SCIENCES

MEDICAL SUPPORT PROGRAM FOR 175-DAY MISSION OUTLINED

Moscow PRAVDA in Russian 5 Sep 79 p 3

[Article by A. Burnazyan, Deputy USSR Minister of Health: "Across the Barrier of Weightlessness"]

[Text] The new space endurance record set by V. Lyakhov and V. Ryumin is 175 days. The chief medical task in that long flight was, of course, to keep the cosmonauts healthy and enable them to continue to function efficiently.

The health of the two cosmonauts was monitored by four shifts of physicians from the Flight Control Center in consultation with experts from the Central Administration of Medical Support of Cosmonauts. When necessary, they were able to make recommendations promptly on all medical problems facing the crew.

The medical specialists were concerned not only with the cosmonauts' physiological reactions but with the maintenance of hygienic conditions in the spacecraft while in orbit. Accordingly, bacteriologic examinations were made while the amount of fluid and food ingested, time of rest, sleep, and work, and physical exercise were checked almost daily throughout the flight.

The orbital flight took place under favorable radiation conditions. The total irradiation dose was 6 to 7 rem (roentgen-equivalent-man - a unit of radiation). This constituted only a small fraction of the permissible level.

The atmosphere in the living compartments reflected theoretical values and was close to the earth's atmosphere. The on-board systems kept the air temperature comfortable for the crew and varied from 15.4° to 21.8°.

During a long spaceflight, the organization of leisure time is very important for cosmonauts. During rest periods the earth provided psychological support. Lyakhov and Ryumin engaged in light, open and interesting conversations with operators and Soviet pilot-cosmonauts well known to them. The musical background of the talk sessions, direct and recorded broadcasts of Mayak programs, conversations with their families and friends, radio concerts, concerts from Ostankino, and, finally, a new word in space science, "earth-to-spacecraft television," played an important role in the psychological support of the crew.

A variety of prophylactic devices were used to prevent adverse spaceflight factors from affecting the cosmonauts. For example, to provide support in weightlessness in the direction of the longitudinal axis of the body, a cosmonaut wearing a special suit is pulled toward the combination trainer's treadmill by rubber ropes. The trainer enables him to walk, run, and jump so that he can execute coordinated movements as if on earth. The prolonged use of the trainer on the Salyut-6 station demonstrated the reliability of its construction, ease of operation, and effectiveness of the recommended exercise sets. A bicycle ergometer was also used.

Both cosmonauts fully understood the importance and need of physical exercise. They never skipped a training session without good reason, even on the days of active rest. Lyakhov and Ryumin worked on the trainer. The physical exertion was greater than on previous spaceflights.

The cosmonauts used a vacuum device in the form of Chibis crimped trousers that create less pressure over the lower part of the body than does atmospheric pressure. It helps to redistribute blood under conditions of weightlessness, simulating earth conditions and thus prevents circulatory disturbances.

Upon returning to earth, it is very important to retain (more precisely, slightly increase) the amount of fluid in the blood stream and in the tissues. Therefore, water and salt supplements were added to the diet before landing.

Among the other prophylactic devices used were a Penguin-3 pressure suit, a Tonus-2 muscle electronic stimulator and a post-landing anti-g suit.

The daily food ration contained approximately 3000 kilocalories throughout the flight. Total water consumption a day was 2 to 3 1/2 liters.

Both crewmen felt well except for a brief period while they were adapting to weightlessness. During the first three days the commander suffered vestibular disorders associated with the sensation of blood rushing to the head and a decline in performance level. From the fourth day on, including the time spent in extravehicular activity, Lyakhov felt well. The engineer adapted to weightlessness without difficulty.

Starting the tenth day, the two men virtually ceased to feel the rush of blood to the head. From the telecasts, especially between the second and tenth days, one could see that their faces were somewhat puffy and that their voices had a nasal twang. Incidentally, vestibular disorders, frequently accompanied by disagreeable reactions, arise in at least every third cosmonaut approximately an hour after the onset of weightlessness but they usually disappear by the fifth day of flight.

Blood pressure and body temperature remained within normal limits throughout the flight. Dynamometry showed that the muscular strength of the commander's hands was the same as before the flight while that of the engineer's right and left hands was 14 and 13 kilograms greater, respectively.

Lyakhov weighed 81.7 kilograms before the launch and 5.5 kilograms less on the day of return. The engineer weighed 1.6 kilograms more on day 163 of the flight than he did before the launch, but after landing he weighed the same as before the flight. Incidentally, of the six cosmonauts who spent 96, 140, and 175 days in orbital flight, only Valeriy Ryumin weighed the same from takeoff to landing.

The cosmonauts underwent thorough medical examinations in which the physicians tried to get detailed information on their heart, blood vessels, and lungs. The on-board instruments, especially Polinom-2M which both cosmonauts can be said without exaggeration to have brilliantly mastered, made it possible to record the following physiological indicators on the ground: electrocardiogram, heart rate, blood pressure, cardiac output, phases of cardiac contraction, venous pressure, vascular tonicity in different parts of the body, and lung ventilation. During the six month flight the men performed 14 medical experiments and ran over 166 studies. The voluntary and patient participation of Lyakhov and Ryumin in the medical experiments, which were sometimes complex and not always pleasant, eased the concerns of the doctors.

It would be wrong, however, to think that the cosmonauts and medical specialists never encountered difficulties. Problems sometimes arose because the physicians were not in a position to evaluate and analyze some of the functions of a healthy person in space, for example, the bioelectric activity of the heart. From flight to flight Soviet and American specialists were confronted with unusual electrocardiograms of cosmonauts, for the most part during a flight, less commonly afterward. Specifically, one of the elements of the electrocardiogram changed in shape and amplitude, as was the case on days 62 and 83 of the Salyut-6 flight. A new (for space science) method of continuous and prolonged recording of an EKG using the portable Kardioskasset machine helped to throw light on these abnormalities. The consultants concluded that the EKG changes are transient and possibly due to positional and metabolic shifts in the myocardium. In general, the cosmonauts' EKG's were judged

to be variants of the normal EKG. Several drugs were prescribed as a prophylactic measure.

The physicians analyzed the current health of the crewmen and made prognoses for the future. They became increasingly convinced that Lyakhov and Ryumin were somewhat more tolerant of weightlessness than other cosmonauts.

Before the men began their extravehicular activity, the medical specialists were in unanimous agreement that they could undertake the important and difficult task of freeing the docking target from the radiotelescope antenna.

The condition of Lyakhov and Ryumin after landing completely satisfied the doctors, who were alongside them within three minutes. The first examination was given 30 minutes later. The cosmonauts were active and slightly euphoric. They felt the increased gravity of the surrounding objects and were unsteady on their feet. The commander suffered vestibular disorders. The pulse rate of both men at rest varied from 100 to 112 beats a minute. Only the commander's blood pressure was insignificantly elevated.

There was no doubt as to the rapid and complete functional recovery of the cosmonauts. The acute stage of adaptation to terrestrial conditions was completed in only three days.

The record flight was a success. This remarkable event testified to the validity of the strategy followed in providing medical support for lengthy spaceflights. The strategy includes careful screening and training of crewmen, optimization of their living quarters, daily monitoring of their health, providing medical care when needed, and execution of prophylactic and recovery measures.

The principal elements of this approach will undoubtedly retain their value for future flights, although we are actively working to improve them.

[79-5214]

CSO: 1866

NOTES ON SPACE BIOLOGICAL EXPERIMENTS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, 1979 pp 38-39

[Article by Candidate of Technical Sciences G. Vasil'yev: "In Order to Fly Infinitely Long"]

[Excerpt] At present the development of ecological life support systems is in the stage of experimental investigations. They are being carried out in ground laboratories and on board satellites, transport ships and orbital stations. An experimental ground complex of life support systems was created in the Soviet Union in accordance with the space program. During the course of a year (from 5 November 1967 through 5 November 1968) an experiment was carried out with the participation of three test subjects. The systems in the complex were designed for test subjects to be in the compartments of a pressurized cabin, functioning of a greenhouse, regeneration of oxygen, drinking and sanitary-household water from urine and a condensate of atmospheric moisture, purification of carbon dioxide and harmful impurities from the atmosphere and utilization of the carbon dioxide.

A unique experiment, lasting 1 1/2 months, was carried out in 1977 at the Institute of Biomedical Problems USSR Health Ministry. The objective was the study of a closed ecological system -- a miniature prototype of future space settlements. No use was made of any physicochemical methods for the purification of water and air. As a result of the careful choice of plants a total balance of the quantity of carbon dioxide released by man and the oxygen absorbed by him was attained. The yield from the space garden and the biomass of algae sufficed for preparing the vegetable part of the food.

At the beginning of the experiment one test subject participated and only the greenhouse operated in the system; the higher plants from this greenhouse were used in regenerating the atmosphere. When the second test subject was added to the experiment an apparatus with *Chlorella* was used in addition to the greenhouse.

The higher plants included wheat, cabbage, peas, beets and carrots. Prior to beginning the experiment specialists grew sprouts of wheat and vegetables in such a way that there was a continuous "conveyor" and each week it was possible to obtain a harvest. The menu was drawn up in accordance with the requirements of physiology and nutritional hygiene. The uniformity of content of different components in the products of man's vital functioning, returning to the system, was taken into account; that is, there was adherence to the reciprocity principle -- a necessary condition for the co-existence of organisms. The health of these test subjects, according to their own reports and the medical examination, was good.

Experiments under real space conditions began with the broadening of the possibilities of cosmonautics. The dynamics of growth of different types of *Chlorella* was studied aboard the "Salyut-6" station. The results indicated that the growth rate for some forms of *Chlorella* under the experimental conditions was three to five times greater than for the control.

Experiments with higher plants are of particular interest for specialists. In particular, they are striving to learn how the growth and development of these plants is influenced by weightlessness and other spaceflight factors.

Unfortunately, the experiments confirmed the fears of scientists. For example, aboard the "Salyut-4" peas died after three to four weeks of growth. But the investigations continued. Different plants were taken on flights. However, the result was the same: the seeds sprouted, the plants developed to a definite stage and died. It was impossible to obtain a full cycle of their development -- from seed to fruit. Only once during the flight of the cosmonauts V. Kovalenok and A. Ivanchenkov did one onion produce a seed stalk. In the remaining cases the plants were undergrown.

What are the facts? What exerts an influence on plants -- weightlessness or other factors? Is it possibly necessary to create artificial gravity on board? More complex and precise experiments will help in answering these questions. Accordingly, with each flight scientists are broadening biological investigations and making the instrumentation more complex. The "Progress-5" freighter delivered the "Biogravistat" instrument to the "Salyut-6" station. This is a small centrifuge which is used for creating artificial gravitation equal to the earth's. Seeds of different plants are placed on the ends of its blades. These very same seeds are placed in the fixed part of the "Biogravistat." The seeds are moistened and the centrifuge rotates up to the time that the first rootlets sprout. Then the seeds are removed and fixed. Their analysis by biologists awaits them after delivery to the earth. The experiments indicated that although the seeds were placed arbitrarily, the rootlets sprouted in only one direction -- from the center of rotation, as if they were planted in terrestrial soil.

Observations of the growth of plants in space made it possible for specialists to draw preliminary conclusions. In particular, they feel that the influence of the unusual spaceflight conditions on the development of plants is obvious and indisputable. This could be a result of weightlessness, cosmic radiation, the gas atmosphere and other factors. A second important conclusion is that plants can grow in a state of weightlessness if favorable conditions are created for them. And third, the plants grown aboard the ship from seeds are entirely suitable for consumption as food.

Thus, the transfer of some elements of ecological life support systems into real spaceflight conditions involves the solution of a number of problems. At the present-day stage in the investigations specialists are trying to ascertain the mechanism of the influence of spaceflight factors on the development of biological objects, in particular on plants.

Despite the complexities encountered, specialists have no doubts that a closed ecological system can be created. This is indicated by the positive results of ground experiments. And some elements of such a system are already being successfully used in manned space flights.

Specialists must still solve more than a few problems before life in a space vehicle will proceed as it does on earth due to the repeated use of elements and compounds, in a cycling of matter controlled by man. On the other hand, after solving this problem man will be able to live and work in space for an indefinite time.

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[31-5303]

CSO: 1866

ABIOTIC SYNTHESIS OF NUCLEOSIDE-LIKE COMPOUNDS TESTED ON SALYUT-6

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249 No 3, 1979 pp 749-752

[Article by M. A. Khenokh, Ye. A. Kuzicheva, N. V. Tsupkina, N. I. Kon'shin, A. L. Mashinskiy and G. S. Nechitaylo, Cytology Institute USSR Academy of Sciences, "Abiogenic Synthesis of Nucleoside-Like Compounds Under Influence of Extremal Factors"]

[Abstract] The abiogenic synthesis of biologically important substances is of great importance in studying the genesis of life on earth and in the universe. A study was made to clarify the possibility of carrying out abiological synthesis of nucleosides under space conditions, taking different energy sources into account. The experiments were carried out in the specially constructed "Meduza" apparatus which held vacuumed ampoules (5.0 x 0.6 cm) of quartz and molybdenum glass containing dry mixtures of: adenine-ribose (I), adenine-desoxyribose (II) and thymine-desoxyribose (III). The apparatus was placed on the outer side of the "Salyut-6" orbital station, apogee 275 km, perigee 219 km; flight duration was 10 months. The contents of the quartz ampoules were exposed to all spaceflight factors. A second series of experiments with exposure of the mixtures in glass ampoules was carried out for ascertaining the contribution of temperature drops in the reaction of synthesis of nucleosides. The temperature during the flight was varied from -50 to +50°C. The results of each experimental variant are presented. It is concluded that in all three mixtures, under the influence of spaceflight factors, there is synthesis of new substances, but these are not components of nucleic acids. All these products had a molecular weight greater than the molecular weight of natural nucleosides. It can be postulated that purines, pyrimidines and carbohydrates synthesized in space and adsorbed on interstellar dust, being subjected to the joint influence of solar ultraviolet radiation and temperature, experience substantial photochemical and thermal transformations and in particular, nucleoside-like substances are formed. Upon reaching the earth, after prolonged chemical evolution, they could be the precursors of biologically significant compounds. Figures 3; tables 1; references 8 (Russian).

[115-5303]

RESULTS OF INVESTIGATION OF OTOLITHIC FUNCTION DURING MANNED SPACE FLIGHTS

Moscow VESTNIK OTORINOLARINGOLOGII in Russian No 6, 1979 pp 21-24

[Article by Candidate of Medical Sciences L. N. Kornilov, G. D. Syrykh, Candidate of Medical Sciences I. K. Tarasov and Doctor of Medical Sciences I. Ya. Yakovleva, Institute of Biomedical Problems USSR Health Ministry, "Results of Investigation of Otolithic Function During Manned Space Flights"]

[Abstract] The objective of this investigation was a study of the effects of prolonged (30 and 96 days) and brief (up to 7 days) space flights on the otolithic function of cosmonauts. The authors present data from the examination of crew members of the spaceships "Soyuz-21"- "Salyut-5" (30 days), "Soyuz-26"- "Salyut-6" (96 days) and "Soyuz-22" and "Soyuz-28" (each 7 days). The intensity of the otolithic reflex was determined on the basis of the antirotation angle of the eyeball with deflection of the body in the frontal plane, making use of the visual after-image. The studies made before and after space flight made it possible to detect the individual nature of changes in the otolithic reflex developing under the influence of flight factors; an increase in the intensity of the otolithic reflex and the presence of asymmetry in the indices of the studied function after prolonged flight; a degree of expression and duration of change in the indices of the otolithic function after prolonged flight which were greater than in the case of brief flight; a possible interrelationship between statokinetic disorders and asymmetry of the otolithic function; and an increase in the otolithic reflex. Figures 1; references 8: 1 Russian, 7 Western.

[109-5303]

EFFECT OF HYDROGEN PEROXIDE AND HYDRATED IRON OXIDES ON METABOLISM OF SOIL MICROFLORA

Moscow MIKROBIOLOGIYA in Russian No 5, 1979 pp 919-926

[Article by A. A. Imshenetskiy, B. G. Murzakov, M. D. Yevdokimova and I. K. Dorofeyeva, Microbiology Institute USSR Academy of Sciences, "Effect of Hydrogen Peroxide and Hydrated Iron Oxides on Metabolism of Soil Microflora"]

[Abstract] In connection with investigations of the possibility that there is life on Mars, a study was made of the effect of hydrogen peroxide and the mineral limonite on the intensity of microbiological processes

in poor and rich soils. The research method is fully described. It is shown that with the addition of hydrogen peroxide to chernozem samples it is possible to register the dynamics of release of CO_2 , demonstrating the existence of metabolism of soil microorganisms. In experiments with desert soil, instead of an increase in CO_2 release there is an increase in the quantity of CO_2 ; this is evidently attributable to an increase in the number of microorganisms forming catalase. The mineral limonite stimulates the metabolic activity of microorganisms. The cultural and morphological characteristics of microflora characteristic for soils incubated in the presence of limonite and hydrogen peroxide are described. The investigation revealed that soils contain microorganisms adapting to high concentrations of hydrogen peroxide. This corresponds to known data indicating that many aerobic heterotrophic microorganisms, with oxidation of certain organic compounds, accumulate high quantities of hydrogen peroxide. The microorganisms have developed a number of mechanisms for its detoxication. In judging the possibility of the existence of life on Mars it is important not only that such microorganisms are present in soils, but that they are stable in the presence of oxygen which is released in an active form under these conditions. The discrimination, identification and detailed study of the physiological and biochemical peculiarities of microorganisms stable in the presence of high H_2O_2 doses is of great importance for exobiology because it makes it possible to obtain data on the limits of adaptation of microorganisms to the conditions prevailing on Mars. This investigation does not preclude the possibility that Martian ground may contain microorganisms which in the course of evolution could have developed even more perfect mechanisms of adaptation to unfavorable environmental conditions. Figures 6; tables 3; references 13: 7 Russian, 6 Western.

[96-5303]

V. SPACE ENGINEERING

SHATALOV DISCUSSES FUTURE POSSIBILITIES OF ORBITAL STATIONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, 1979 pp 36-37

[Article by V. Shatalov, Lieutenant General of Aviation, Twice Hero of the Soviet Union, USSR Flier-Cosmonaut: "Orbital Stations: Prospects and Problems"]

[Text] Since 1971 Soviet cosmonauts have been carrying out regular scientific investigations aboard orbital stations. The level of development of these vehicles is convincingly demonstrated by the operation of our last station, the "Salyut-6." Aboard this vehicle three crews established spaceflight endurance records, an enormous volume of research and experimentation was carried out and a series of new and complex problems were solved in the interest of further developing this fundamental direction in cosmonautics.

The turning of Soviet science to orbital stations as a decisive means for man's extensive conquest of space was by no means random. In the development of cosmonautics, as in any major and serious undertaking, a certain logic is present. The achievements of our country in space exploration are widely known: the first satellite, the first manned flight and the first launchings of automatic stations to the moon, Mars and Venus. But with advances in this new field of human activity the indisputable fact became increasingly obvious that man's fundamental conquest of space is possible only with the creation of permanent bases there -- long-term orbital stations. Accordingly, after launching the "Vostoks" and "Voskhods," our manned flight program was directed to the progressive solution of all the problems involved in the development of orbital stations.

And there were many such problems. These include maneuvering in orbit, search, rendezvous and docking of space vehicles and transfer of cosmonauts from ship to ship. The problems of precise orientation and stabilization of vehicles and life support during prolonged flights were of great

importance. It was necessary to be sure that man can not only endure prolonged flight in space, but also retain a high level of performance. It was also necessary to ascertain the effectiveness of different methods for remote investigations of the earth from orbit.

The "Vostok" and "Voskhod" ships did not make it possible to solve these problems. A multipurpose manned vehicle was needed. The "Soyuz" was such a vehicle. The use of one and the same ship for different purposes facilitated the development of a complex space system and reduced the cost.

The creation of the "Soyuz" marked a new stage in the development of manned vehicles. The presence of two living compartments, reliable on-board systems and engines and a docking unit aboard it made it possible to carry out prolonged flights to conduct a detailed study of the effect of space factors on the human body, to test maneuvering and docking with other ships and to carry out extensive scientific research programs.

The "Soyuz" not only made it possible to solve all the problems involved in the development of an orbital station, but when it was created, began to perform successfully the role of a transport ship. Later, on this basis and with minimum expenditures of time and money, the "Progress" automatic freighter was developed. The profound scientific and technical soundness of the "Soyuz" program yielded the anticipated results. Now we have a well-tested long-term orbital manned system consisting of an orbital station, manned transport and automatic freight ships. We are close to the constant operation of orbital stations -- to around-the-clock and year-round work of cosmonauts aboard them, replacement of crews directly aboard the stations and regular delivery of the necessary materials into orbit. In the initial stage of space exploration some scientists doubted the possibilities of man actively working in space, and the maximum automation of all on-board processes was proposed. However, experience revealed that in space a crew is capable of performing any complex task, almost as if on earth. At the same time, something else came to be understood: it is not only difficult but also inefficient to automate all the processes aboard space vehicles. While systems and equipment are in operation there are frequently situations which are virtually impossible to provide for in the instructions and programs. The crew's creativity is necessary for handling them. The advantage of manned orbital scientific stations over automatic space vehicles is precisely that they carry a crew capable of changing and supplementing the work program, finding optimum solutions when unforeseen situations arise and detecting and eliminating malfunctions.

Only the active participation of man in space could sharply expand the front of scientific research and create a reliable technology for his prolonged work in orbit. Accordingly, most scientists were for an expanded, rather than a restricted, role of man aboard a station. The

flights of the last crews fully confirmed the validity of this point of view. Our cosmonauts manifest a creative approach toward the solution of the most different problems; they demonstrate inventiveness and resourcefulness. Many of them have revealed a talent as real researchers. And this is evidenced in the effectiveness of the expeditions and the depth of the investigations.

However, the operation of stations has indicated that some processes can and must be automated. The cosmonauts must be freed from constant monitoring of the state of some systems, from performing work which can easily be dealt with using automatic systems. And we will do this as automation systems and computers are developed.

As a rule, all our orbital stations are outfitted with dozens of scientific and experimental units, each of which includes hundreds of instruments. Naturally, many ask the question: is it necessary to have such a diversity of scientific equipment on a single station? Indeed, it cannot be used simultaneously. While photographing the earth's surface, for example, astrophysical observations cannot be carried out. Solar and x-ray telescopes also require different station orientation. And in technological experiments it is frequently undesirable to have the slightest movement of people on the station. And after all, the possibilities of a crew are not unlimited.

Does such a diversity of scientific instrumentation on a station not reduce its efficiency? Would it not be correct to create stations designed to solve specific problems, to pursue only one direction in research -- biomedical, astrophysical, for investigations of the earth?

At first glance it appears that we are faced with the problem of choosing one of two basic routes. But in actuality, there is no problem here. In my opinion, both directions must be developed simultaneously, mutually supplementing one another.

In actuality, the research equipment on specialized space vehicles can be used more effectively. But it must be remembered that at the present time in the basic directions of research the search is continuing for the most effective methods for obtaining scientific information; the design of instruments and equipment is being tested. And so, evidently, it will still continue for quite a long time. Therefore, multipurpose orbital stations, on which not only specific experiments are carried out, but most importantly, research methods and equipment are checked, will also play an important role in the future.

The specialization of orbital stations will evidently follow as these problems are solved. The matter of including scientists and specialists in crews can arise in some stage.

The mastery of space is occurring at a rapid rate. In principle it is already possible to realize projects for orbital stations with a crew of 10-20 or more men.

Should we not be concerned with such projects at the present time? Have the possibilities of existing stations been exhausted?

It seems that the economic and scientific-technical advantage of large stations for the time being still appears doubtful and the possibilities of our "Salyuts" are far from exhausted.

The "Salyut" stations are being improved simultaneously in several directions. Their operational and research capabilities are being expanded, their reliability is increasing and the conditions for life and work of the cosmonauts are improving. Progressively improved in design, they differ quite significantly.

Although with respect to mass and size the "Salyut-6" is close to its predecessors, its research and operational capabilities are, nevertheless, far broader. The installation of a second docking unit made it possible not only to increase flight safety, but also to ensure the delivery of additional equipment and materials by means of automatic freighters.

A number of systems which underwent checking on preceding stations and were experimental became standard on "Salyut-6." For example, the heat regulation and orientation systems. A shower, two-directional television system, teletype communication, a water regeneration unit and many other components appeared on the station.

But in every case the scientific equipment on the stations is subject to the greatest changes. From year to year it is becoming more perfect, convenient and precise. The scientific equipment on our last station has already been described in AVIATSIYA I KOSMONAVTIKA, No 6 [cf. JPRS 73852].

During the past year "Salyut-6" was visited by three international crews in addition to the main crews. Thus, four men were simultaneously aboard the station. This indicates that with appropriate support the station crew can be doubled and, if necessary, increased still more.

There is still another important factor which forces us not to hurry with the creation of large stations. I have in mind the disproportion between the rate of collection of scientific information and the rate of its processing. This is a matter of great concern to scientists, designers and cosmonauts. Now when a crew works aboard an orbital station for one month we obtain so much scientific information about the earth, its environment and natural resources that years are required for its processing. And the problem here is by no means a matter of miscalculations. It is simply that former data processing methods do not correspond to the new situations.

Each of our space expeditions delivers thousands of all possible types of photographs to the research centers of the country. A great contingent of specialists is working on them. Using these photographs geologists determine regions which are promising for gas and petroleum. They are assisting builders in selecting the sites for future hydroelectric power stations, routes for canals, railroad lines and high-voltage power transmission lines. Foresters are using them for inventories of forest reserves. Space photographs are being employed in refining maps of soils and vegetation and are used in determining ground water reserves.

It is impossible even to enumerate the types of information extracted from photographs. But unfortunately for the time being this is being done slowly. And this means that the economic advantage is coming slowly. It has become obvious that the processing of space survey materials must be carried out on the basis of highly productive automated systems. Accordingly, the question arises of equipping scientific centers, ministries and departments with corresponding units. Well-trained specialists are also necessary. And all this requires time and money.

An increase in the useful life of orbital stations is inseparably associated with an increase in the reliability of all its systems, instruments and assemblies. This is no simple problem. Even on the earth not one machine operates continuously over the course of many months and years; it requires preventive maintenance and the replacement of parts. In space the situation is saved by the crew. It can be said with complete assurance that the prolonged operation of the "Salyut-6" station became possible only due to the cosmonauts. It has no equal with respect to the volume of preventive maintenance and repair-restoration work carried out aboard it.

But in order for such work to be carried out effectively, the possibilities for reconstruction must be incorporated in advance in the design of the station and its equipment. Otherwise even the most experienced crew can do nothing.

Aboard the station there are thousands of all possible devices, instruments and mechanisms. Naturally, it is impossible to make all of them suitable for repair; for this the station would have to be broken down in space to the last screw. This means that it is most important to ensure the restoration of those systems which are related to the life support of the crew, its safety.

Evaluation and normalization of suitability for repair are by no means simple problems. Whereas for ground equipment they have enormous importance, this is all the more true of the equipment used in space. The real reliability of the equipment aboard a space vehicle can be evaluated most completely only on the basis of information on its behavior in operation. Therefore, the reliability and completeness of the

information arriving from cosmonauts is acquiring particularly great importance. In this case designers can achieve an increase in reliability without radically changing the design of systems and instruments but rather by further improving individual units or replacing weak elements.

When improving orbital stations specialists never forget that people work aboard them and to a decisive degree they determine their effectiveness, reliability and longevity. But in order for cosmonauts to be able to work aboard stations with a complete input of their efforts and in order for their performance not to be reduced during long flights, the greatest concern must be given to the organization of their work, living conditions and rest. The prolonged flights of our cosmonauts are not an end in themselves; they are not a pursuit of records. The longer the flight, the greater is the experience which the crew acquires in the operation of the systems and the scientific equipment aboard the station and the greater is the skill in observing features of the earth's surface, its atmosphere and space. On such a flight it was established that a manned complex for a long time can be in a state of gravitational stabilization, when not a single engine is operating but the station stably retains its spatial position, ensuring implementation of a great number of experiments.

Long-term observations of the ocean from space made it possible to establish the possibility of directing ships of the fishing fleet into regions where fish were plentiful. The first experiments indicated great promise and great material advantage. All this indicates that in the years immediately ahead there can be a considerable increase in the economic effectiveness of such investigations. This requires communication between the crews of orbital stations and ships at sea, a knowledge of their coordinates and the coordinates of the regions of fish concentration closest to them.

The long-term work of crews reduces the required number of transport ships and boosters necessary to deliver replacement crews to a station. This also increases the economic advantage of research.

I will not take it on myself to predict the optimum time for crews to remain aboard orbital scientific stations; but before it is determined, specialists in different fields of science and technology must weigh and think through everything.

"Salyut-6" has much of what we would like to see aboard long-lived stations. The regular orbital flights of transport ships and freighters has appreciably facilitated the solution of the problem of feeding cosmonauts. It has become possible to deliver foods in accordance with their wishes. Aboard these ships they receive mail and videotapes. Two-directional television has seemingly brought them closer to the

earth; they no longer feel isolated from their group, their comrades.

There is a well-planned regimen of work and rest aboard "Salyut-6." Measures taken by the psychological support group and television meetings with friends and relatives have a favorable effect on the mood of the crews. It is evident that further work in this direction is required.

The 25th Congress CPSU laid out a clear program for the use of space vehicles in the interest of different branches of the national economy. The implementation of the Party goals is the duty of all who are working in cosmonautics.

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DESIGN OF "METEOR" SERIES SATELLITES DESCRIBED

Moscow TEKNIKA -- MOLODEZHI in Russian No 9, 1979 p 23

[Article by Engineer Marina Marchenko]

[Excerpt] In the Soviet Union meteorological observations from space were made for the first time from aboard the "Cosmos-144" artificial earth satellite, which was launched on 28 February 1967. The experimental "Meteor" system began to operate two months later. It consisted of the "Cosmos-154" and "Cosmos-156" artificial earth satellites. Since 1969 the meteorological satellites have been named "Meteor," the same as the system as a whole.

In design the satellites of this series consist of two sealed compartments. One of them, the instrument compartment, which is situated in the lower part of the satellite, holds the instrumentation for meteorological observations. The other, the power plant compartment, holds the main servicing systems: the radiotelemetry system, the thermal regulation system, and chemical batteries for the electric power supply system. On the outside of this compartment are the large flat panels of solar cells which are extended after separation of the satellite from the booster. In contrast to the solar cells which usually are rigidly attached to the hull of a satellite or automatic interplanetary station, the solar panels on the "Meteors" are movable; they can be turned in such a way that the sun constantly illuminates the sensing elements of the cells (with the exception, to be sure, of those periods of time when the entire satellite is in the earth's shadow). Such a rotatable system and the great area of these panels, in combination with the chemical buffer batteries, make it possible to ensure a power supply for all the instrumentation in different modes over a period of many months.

In order to carry out high-quality observations of the earth's surface the longitudinal axis of the satellite, along which the axes of the recording instruments are also oriented, is constantly directed toward the center of the planet. But this is inadequate: the satellite must be stabilized along two axes. Its initial damping after separation from the booster and the orientation of its axes are accomplished by micro-engines of the gas-jet system. In subsequent flight the orientation and stabilization of the satellite are accomplished by a combined electric flywheel system in combination with a moment magnetic drive, making use of the earth's magnetic field. In order to monitor the orientation of the satellite axis, use is made of sensors of the earth's thermal radiation which can operate regardless of whether the satellite is over the daytime or nighttime side of our planet.

The meteorological instrumentation on the "Meteor" satellite consists of television (TV), infrared (IR) and actinometric (A) instruments. It can

operate in cycles of different duration; switching on and off is accomplished both in accordance with a pre-planned program and by commands from the control center. The meteorological data are registered by on-board apparatus with a memory and then are transmitted to ground stations of the "Meteor" system.

The TV equipment is used in making observations of the cloud cover on the daytime side of the earth. The survey is made with two cameras, one of which scans the right, and the other, the left side of a band along the satellite trajectory. The width of the band scanned by the TV cameras is about 1,000 km.

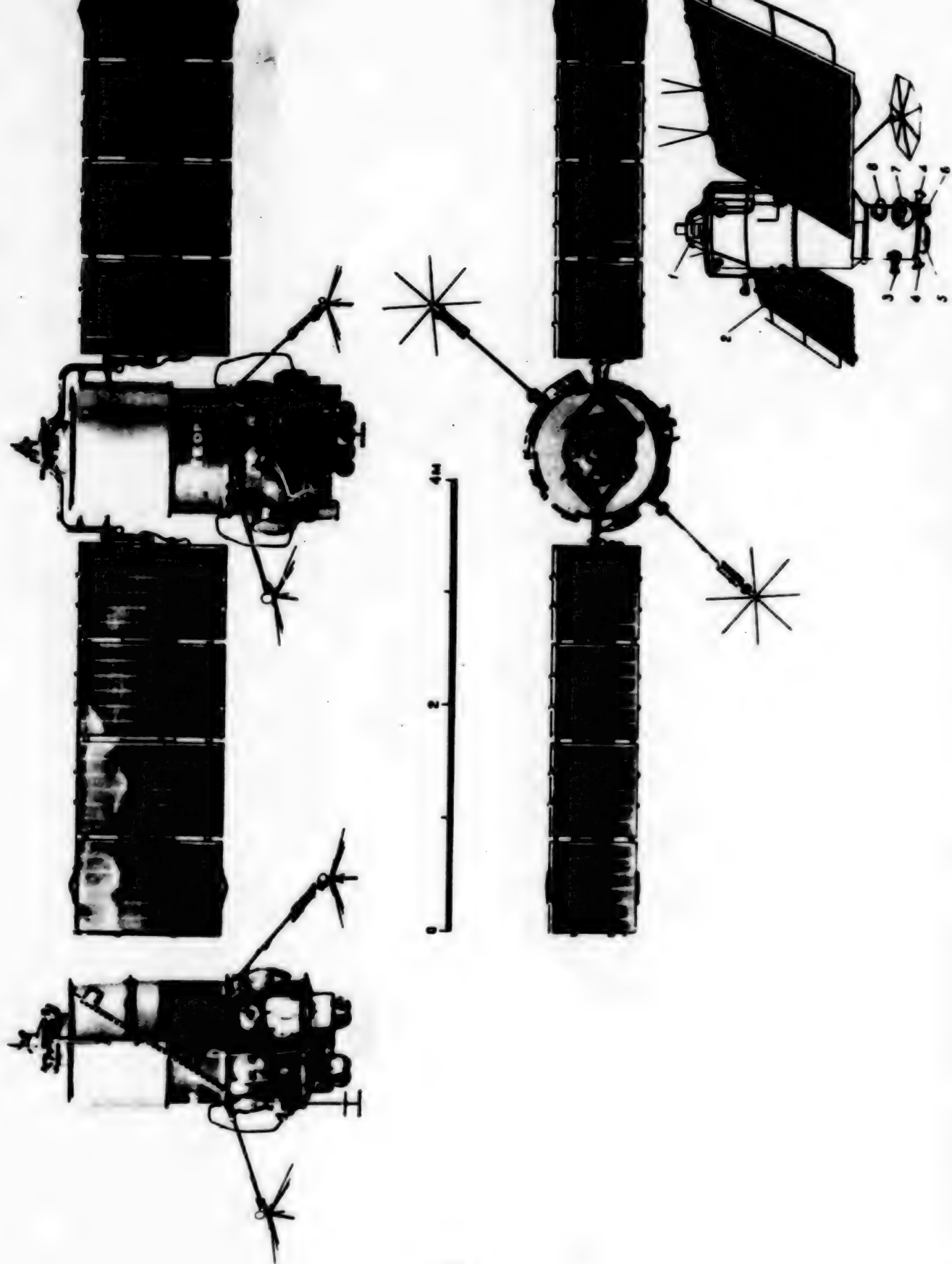
The IR equipment is used for observations of cloud cover for the most part on the nighttime side. It is adjusted for registering the thermal radiation of clouds or the earth's surface. The range in which the IR apparatus operates (8-12 μ) makes it possible to carry out observations on both the daytime and nighttime sides of the planet. In these observations a band also with a width of about 1,000 km is scanned.

The photographs obtained using the TV and IR equipment make it possible to detect features of the structure of cloud formations that cannot be observed from ground-based meteorological stations, and the TV and IR information together make possible a more reliable evaluation of synoptic conditions and the nature of the development of atmospheric processes.

The actinometric apparatus registers the radiation fluxes emanating from the earth in the ranges 0.3-3 μ , 3-30 μ and 8-12 μ . A band with a width of about 2,500 km is "scanned." These observations make it possible to compute the heat "budget" of our planet, determine the temperature of the land and ocean surface, ascertain the boundaries of ice cover, and calculate moisture content in the atmosphere.

During one revolution around the earth the satellite receives TV and IR information from a territory of about 8% and data on radiation fluxes from 20% of the earth's surface. A system of two satellites, that fly in circular circumpolar orbits at an altitude of 625-630 km, whose orbital planes intersect at an angle of about 95°, in the course of 24 hours gives information from half the earth; each of the planetary regions is observed at six-hour intervals.

A ground system for the collection, processing and dissemination of meteorological information has been established in the Soviet Union. Naturally, computers are used for ensuring its routine use at ground stations.



The figure illustrates the "Meteor-2" artificial earth satellite (in three projections). The diagram shows the design of the "Meteor-1" artificial earth satellite. The figures denote: 1) servomechanism for orientation of solar cells, 2) solar panels, 3) orbital monitoring instrumentation, 4) antennas, 5) phototelevision cameras, 6) magnetic sensor, 7) actinometric apparatus sensor, 8) IR detector. Figures drawn by Mikhail Petrovskiy.

Edited by: Boris Raushenbakh, Corresponding Member USSR Academy of Sciences, Winner of the Lenin Prize; Valeriy Kubasov, Candidate of Technical Sciences, USSR Flier-Cosmonaut, Twice HSU; Gleb Maksimov, Candidate of Technical Sciences, Winner of the Lenin Prize

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VI. SPACE APPLICATIONS

GEOLOGICAL INVESTIGATIONS FROM SPACE

Moscow ZEMLYA I VSELENNAYA in Russian No 5, 1979 pp 7-11

[Article by Candidate of Geological and Mineralogical Sciences V. N. Bryukhanov, "Geology in Space"]

[Abstract] Surveys from space laid the foundation for space geology, a new and highly effective branch of geology. In geological research from space it is possible to find and study elements of deep structure which cannot always be detected by other methods. Such information is very important in forming correct ideas concerning the history of the earth's development and the patterns of distribution of minerals. The information obtained from space vehicles often does not concur with ordinary concepts concerning the geological structure of the surveyed regions and in some cases forces a reexamination of prevailing points of view concerning its development, patterns of mineralization or prospects for finding petroleum and gas. For example, on photographs of the shores of the Sea of Okhotsk there were very large concentric formations which were visible through rock strata many kilometers thick and which are not reflected in the present-day geological structure of this territory. It has now been established that such annular structures play a significant role in the distribution of deposits of a number of minerals. Similar to structures observed on the surface of the moon, Mars and other planets, these annular structures were evidently formed in early stages of crustal formation. Space photographs have revealed their presence in Transbaykalia, in the northeastern USSR, in Yakutia, on the Kola Peninsula and in other regions. Magmatic rocks of deep mantle origin are localized in the central parts of the annular structures. The peripheral zones are occupied by less deep granitoid formations. Accordingly, in the central parts of the annular structures there may be deposits of copper, nickel, chromium and titanium. On the other hand, on the periphery of these structures there may be deposits of rare and disperse elements, gold and other metals. Space photographs have revealed such structures in the Vilyuy River valley and in the valleys of its left tributaries -- the

Tyukyan and Tyung Rivers. These structures are interesting from the point of view of possible discovery of petroleum and gas deposits. A relationship between gas deposits and annular structures was earlier established in Ciscaucasia. These are but a few examples of the great diversity of geological applications of space photography. Other uses include: theoretical studies of development of the earth's crust, compilation of regional maps and maps of tectonic, hydrogeological and geological engineering regionalization, the investigation of the movement of shorelines, the study of zones of active volcanism and high seismicity to aid prediction of earthquakes and volcanic eruptions, and the study of the dynamics of relief formation. Figures 5.

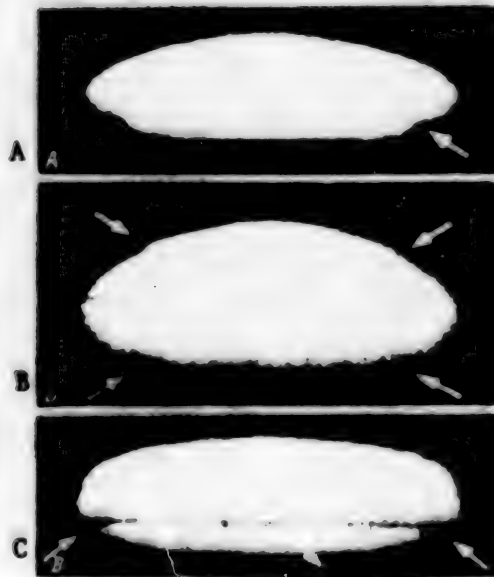
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DETERMINATION OF ATMOSPHERIC TEMPERATURE FIELD USING SPACE OBSERVATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248 No 4, 1979 pp 828-831

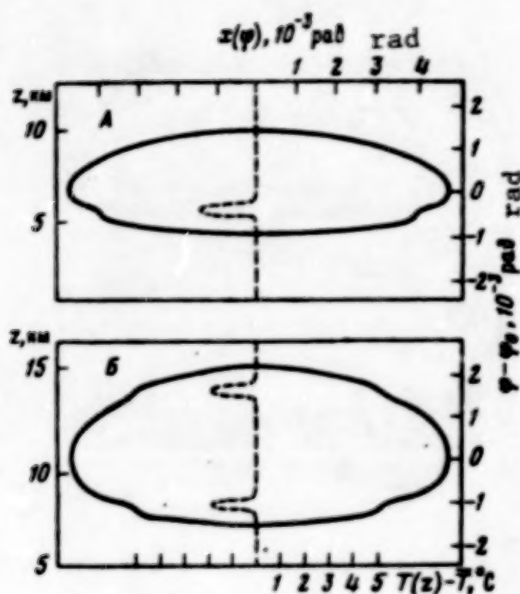
[Article by G. M. Grechko, A. S. Gurvich, Yu. V. Romanenko, S. A. Savchenko and S. V. Sokolovskiy, Institute of Atmospheric Physics, "Vertical Structure of the Atmospheric Temperature Field According to Observations of Refraction from the 'Salyut-6' Orbital Station"]

[Abstract] During their stay aboard the "Salyut-6" G. M. Grechko and Yu. V. Romanenko observed that deformations in the form of "steps" are frequently observed at the solar limb, that is, they observed a finer structure of the image than the simple flattening caused by a smooth decrease in the refraction angle with altitude. In order to make a quantitative analysis the sun was photographed at sunrise and sunset using an objective with a focal length of 0.9 m. Three of the photographs showing these limb deformations are reproduced below.



Solar images visible through earth's atmosphere taken from aboard the "Salyut-6" orbital station. The "steps" are designated by arrows.

These deformations of the solar image can be explained by taking into account perturbations of the angles of refraction caused by variations in the vertical temperature profile characteristic for temperature inversions.



Computed images of solar limb: φ_0 -- direction to center of sun. The dashed lines indicate temperature disturbances. For A: $a = -2.5^\circ\text{C}$, $\Delta = 1.2$ km, $z_x = 5.5$ km; for B: $a = -2^\circ\text{C}$, $\Delta = 1.2$ km, lower step $z_x = 8$ km, upper step $z_x = 14$ km.

The diagrams and formulas presented in this paper support this conclusion. The experiment and its processing show that small-scale nonuniformities of the temperature profile can make a contribution to refraction adequate for the appearance of appreciable deformations of the solar image. This indicates that it is possible to use refractometric methods for detecting the fine structure of the temperature profile in the atmosphere. Existing methods for thermal sounding of the atmosphere do not have a resolution adequate for detecting temperature profile nonuniformities with the parameters considered in this investigation. Figures 3; references 5: 4 Russian, 1 Western.

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SPACE PHOTOS AID IN MONITORING OF OIL POLLUTION

Leningrad LENINGRADSKAYA PRAVDA in Russian 30 Oct 79 p 4

[Abstract] Scientists at the Institute of Oceanology imeni Shirshov and other oceanological and hydrometeorological institutes in Leningrad have been studying problems involved with the remote sensing of oil slicks that form on the ocean's surface. They have developed methods for interpreting space photographs which can reveal the dimensions and composition of the oil films as well as the direction and speed of their drift. Researchers who participated in this space applications project have presented their findings at an all-union conference in Baku.

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VII. LAUNCH TABLE

Date	Designation	Orbital Parameters				Notes
		Apogee	Perigee	Period	Inclination	
27 Nov 79	Cosmos-1145	652 km	629 km	97.3 min	61.2°	
5 Dec 79	Cosmos-1146	497 km	441 km	93.9 min	65.9°	
12 Dec 79	Cosmos-1147	407 km	207 km	90.3 min	72.9°	
16 Dec 79	Soyuz-T	232 km	201 km	89.6 min	51.6°	Modified Soyuz transport ship; unmanned; docked with Salyut station 19 Dec 79
28 Dec 79	Cosmos-1148	367 km	180 km	89.7 min	67.1°	
28 Dec 79	Gorizont	36,000 km		24 h 23 min	0.8°	Cosmos launched as part of TV satellite system for broadcasting 1980 Moscow Olympic Games

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